Title: Get to the Route of It!

Brief Overview:

This unit incorporates concrete application of measurement tools, geometry vocabulary, and problem solving skills. The students will discover and apply the skills necessary for writing clear directions which will accurately guide classmates from one location to another.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers and problems which are solved in a cooperative atmosphere.

- **Mathematics as Communication**
  Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with language and the signs, symbols, and terms of the discipline.

- **Mathematics as Reasoning**
  Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.

- **Mathematical Connections**
  Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.

- **Estimation**
  Students will demonstrate their ability to apply estimation strategies in measurement and in problem solving. They will determine reasonableness of solutions.

- **Geometry and Spatial Sense**
  Students will demonstrate the ability to apply their knowledge of angles in concrete and abstract situations. They will apply geometric relationships to two and three dimensional objects.

- **Measurement**
  Students will demonstrate and apply concepts of measurement. Students will determine and use appropriate tools to measure angles. They will estimate and verify measurements. They will apply the measurement of angles to real-life problems.

- **Patterns and Relationships**
  Students will demonstrate their ability to recognize numeric and geometric relationships.

Grade/Level:

Intermediate, 4 & 5

Duration/Length:

Approximately 1 week

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Simple measurement concepts
- Use of rubrics

Objectives:

Students will:

- work cooperatively in groups.
- measure, label, and draw angles.
- write clear directions which enable others to find a particular location.
- distinguish between acute, right, and obtuse angles.
- use a rubric to design and evaluate projects.

Materials/Resources/Printed Materials:

- Pipe cleaners and coffee stirrers to make angle models:
  Cut pipe cleaners into two inch strips. Cut coffee stirrers to 3 or 4 inch strips. Insert pipe cleaners into 2 coffee stirs to create angles which can be used as manipulatives.
- Protractors
- Tools for measuring length - rulers, yardsticks, string or yarn
- Index cards, 3x5
- Overhead projector
- Copies of student worksheets and overheads

Development/Procedures:

Day 1

Pass out Student Resource 1 and put a copy on the overhead projector. Have the students work in pairs to write clear directions on blank sheet of paper telling how to get from start to finish. Allow the students to work on this for 5 to 10 minutes. After students have finished, collect their directions only.

Have the students listen and follow classmate's directions as you read them aloud. You may also want to choose one student to use a counting chip to follow directions on the overhead. When directions are unclear discuss why they are difficult to follow. [The goal here is for students to see that clear directions include directional words, distance words, reference points, and degrees of angles when turning.]

WHAT IS AN ANGLE?

Explain to the students that angles and circles are very closely related. Have students brainstorm to list everything they know about circles. To lead students to identify degrees in a circle, ask them to discuss the following questions in groups: "In skateboarding, snowboarding, or skiing, what is the name of the move when the athlete jumps and turns half-way around?" (a 180) and, "Do you know of any other similar moves?"

When students have finished their discussion in groups, put the "Degrees in a Circle" (Student Resource 2) overhead up and have students fill in the degrees. To help the students internalize the degrees of an angle, play "Simon Says" using degrees of an angle.

The students will stand and turn their bodies to show the degrees in the angles you call out. Until the students are comfortable with this game, leave the overhead up while you play. *You may want to make a poster of this overhead to display throughout the unit.

Homework: Have the students go home and list and diagram 7 angles they find around their house.

HOW ARE ANGLES MEASURED? Day 2

Have students share the angle lists they gathered for homework. To extend this, they can play "Mystery Angle", where one student finds an angle in the room and the other students ask 20 questions and try to locate the angle.

Put "What's Your Angle?" (Student Resource 3) on the overhead and ask students to discuss the following question in cooperative groups; "How do mathematicians tell one angle from another?" You are leading them to the realization that we must accurately measure angles in order to be able to distinguish among them.

Brainstorm a list of mathematical tools which may help us to measure angles.(Past experience or ability level may eliminate the need for this activity.)

Have students work with a partner and **use a ruler** to measure the angles on the "What's Your Angle" worksheet. Ask them to discuss their results. They will have many problems using rulers as a measuring tool. Ask them if there is any other tool that might work better than a ruler. Introduce the protractor as a tool that measures the degrees in a circle.

Provide protractors for all students to use during this exploration activity. Have an overhead and individual copies for each student so that you may model the proper use of the protractor for your students. WATCH OUT FOR STUDENTS WHO ARE CONFUSED AS TO WHICH DEGREE NUMBER TO READ!

Homework: Cut out a picture from a magazine with at least 3 different angles. Measure and label each angle.

DRAWING AND NAMING ANGLES. Day 3

Have students exchange last night's homework and use protractors to check their partner's measurements. If they don't agree, they must work together to find the correct measurement before the assignment is turned in.

To assess the students' ability to use a protractor to measure angles, have them complete "Measuring Angles" (Student Resource 4). Students must first predict the degrees in the angles and then use the protractor to accurately measure them.

Introduce the different types of angles to your students by showing "What's Your Angle" on the overhead. Explain that while these angles are not exactly the same, they are very similar. Mathematicians like to put things into categories and they have special groups for angles too.

Pass out baggies of pipe cleaners and coffee stirs. Allow the students to play with them for a minute or two. Ask them to make any angle using two coffee stirs and a pipe cleaner. Have them hold up their angles for everyone to see. Use their angles to complete a concept attainment on the blackboard. Have three numbered columns.

Choose a student holding an acute angle to tape it under column one, a student holding a right angle to tape it under column 2, and a student holding an obtuse angle to tape it under column 3. Have the rest of the class tape their angles where they think they belong.

Hold a class discussion to be sure all angles are appropriately placed. Find common attributes of each column and list them under the corresponding category on chart paper. At this time, lead the class to discuss each column in terms of the measurement of the angles. Once the students understand that all the angles in column one measure 1 - 89 degrees, all the angles in column 2 measure exactly 90 degrees, and all the angles in column 3 measure more than 90 degrees, give them their proper names (acute, right, obtuse). To reinforce these names, have the students stand behind their chairs and make the different types of angles with their arms or bodies.

At this time show the students how to draw an angle using the protractor by modeling on the overhead. Have them practice making angles with the pipecleaners, measuring them with the protractor, and then drawing the same angle using the protractor.

To assess the students' ability to properly use the protractor, have them work independently to complete "Are you A skilled Angler?" (Student Resource 5) Review the important components of clear directions: directional words, distance words, reference points, and degrees of an angle.

Homework: Write new directions for the opening activity (Student Resource 1). Be sure to include the measurements and names of the angles included in your directions.

Day 4

Have students share their new directions with partners then discuss what was better about their second set of directions. Have a student follow directions with a counting chip on the overhead. Have a short class discussion of how the new skills helped improve the students' ability to give clear directions. Make a list of the important components of clear directions.

Performance Assessment:

- Teacher may read The Secret Birthday Message (Eric Carl) as motivator.
- Following prompt, cooperative teams of students design scavenger hunt routes for use as their class activity at a school family festival. Teams set up routes and write directions for hunt. (Student Resource 6)
- Using measuring materials, fellow students follow each group's written directions and complete a rubric evaluation of each route.
- Class votes on choice of best scavenger route.
- Teacher uses Rubric to evaluate each team's ability to successfully use tools to measure angles and write clear directions.
- As an extension to scavenger hunt activity, students use Logo program to draw designs. Put directions on to 3x5 cards for other students to follow with pencil, protractor, ruler and paper at a center. Check "mystery" picture with printed logo model taped at back. (see sample)

Extension/Follow Up:

As an extension activity, students will construct their own labyrinth out of a shoebox and index cards. They will then give directions that will enable a partner to navigate their maze.

The following materials will be needed for this extension activity:

Adventures of the Greek Heroes by Mollie McLean and Anne Wiseman
Index cards
Glue
Scissors
Cardboard boxes
Geoboard Dot paper (Student Resource 7)
Compass Cut-Out (Student Resource 9)
Magnets
Paperclips

1. Read the story "Theseus and the Minotaur" found in the book Adventures of the Greek Heroes. In this story, a horrible, man-eating beast called the Minotaur lives in a great labyrinth under a castle on the island of Crete. In order to save the citizens of his country from being fed to the Minotaur, Theseus volunteers to enter the labyrinth and slay the Minotaur. With the help of Princess Ariadne and her magic ball of thread, Theseus is able to navigate his way through the labyrinth and kill the Minotaur.

2. Distribute Geoboard dot paper. Students will create a symmetrical design on the paper. You may want to give the students complete freedom in creating their design, or you my want to use this as an opportunity to tie in other geometry concepts by using the attached list of specific guidelines (Student Resource 8). After the students have created their dot paper maze, they will write instructions to guide their partner through the maze.

3. To convert the maze into 3-D, each pair of students will need to bring in a cardboard box. You will need to provide index cards, scissors, and glue. Students will fold a 1 cm tab on the bottom of each index card. Students will then arrange the cards so that the tabs are resting on the perimeter of each shape in their labyrinth. Make sure that the tabs do not obstruct the path. Then glue the cards in place. Once the cards are securely in place, students will glue the maze into the bottom of their shoebox.

5. Students will trade mazes and instructions with a partner. Students will turn box upside-down and suspend between two desks so that they can reach in from underneath. Each pair will need two magnets, and one copy of the circular compass (Student Resource # 9). Students will glue one magnet to the center of the circular compass, and place it on top of their overturned box.

6. In each pair, the student who created the first labyrinth will be the guide, and the partner will be the explorer. The guide will read the instructions to the explorer. The explorer will place the second magnet inside the box. The second magnet will be hidden from view, but the explorer will be able to see his progress through the maze by watching the motion of the compass. If the guide's directions, cause the explorer to hit a wall, the magnet will drop, and the guide must revise the directions.

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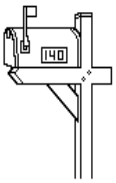
Write Directions to get from the beginning to the end of this path so that someone without a map can follow them.

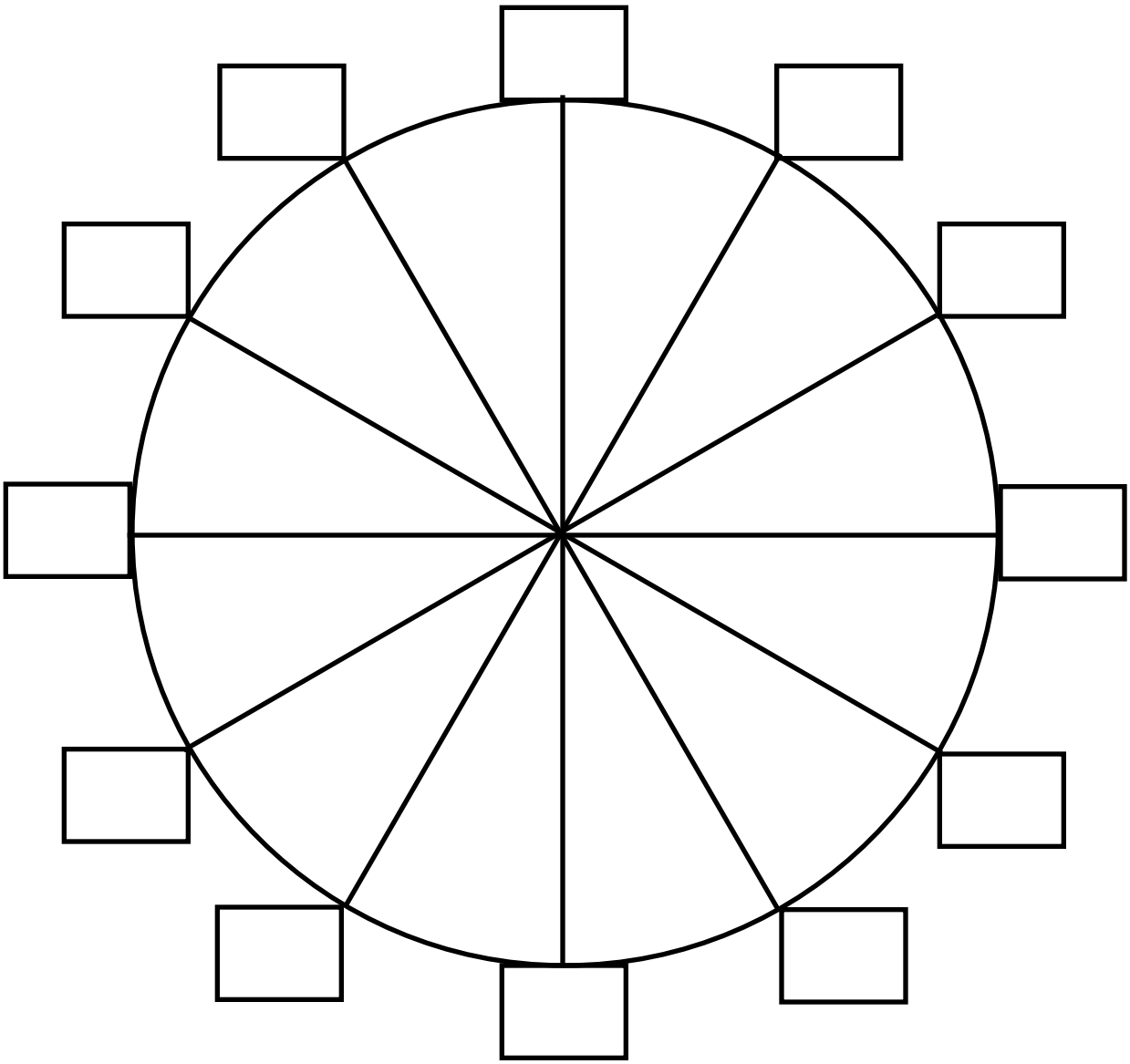
END HERE

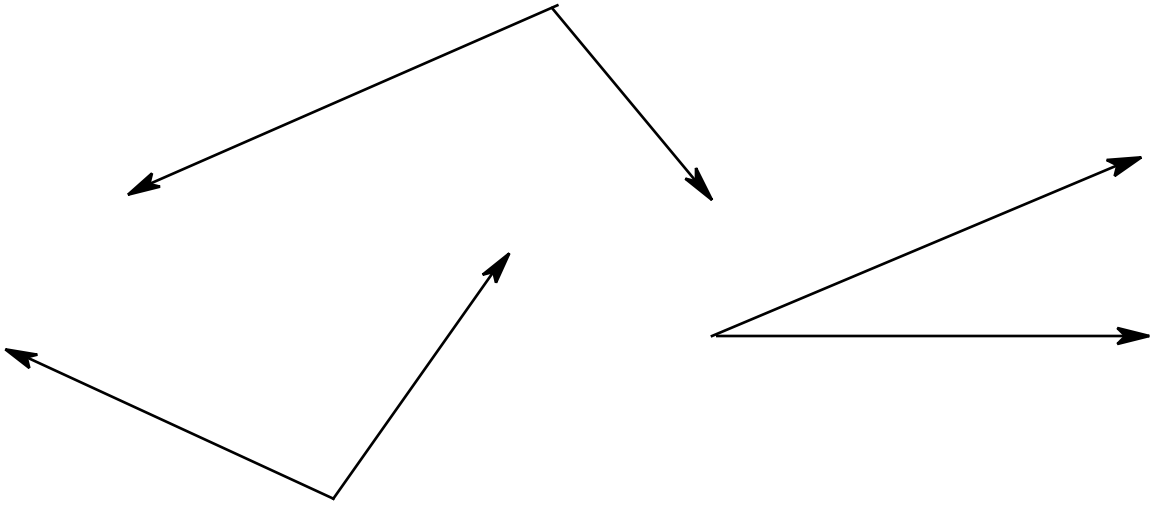


Scale:
1 cm = 1 step
round to nearest cm.

START HERE

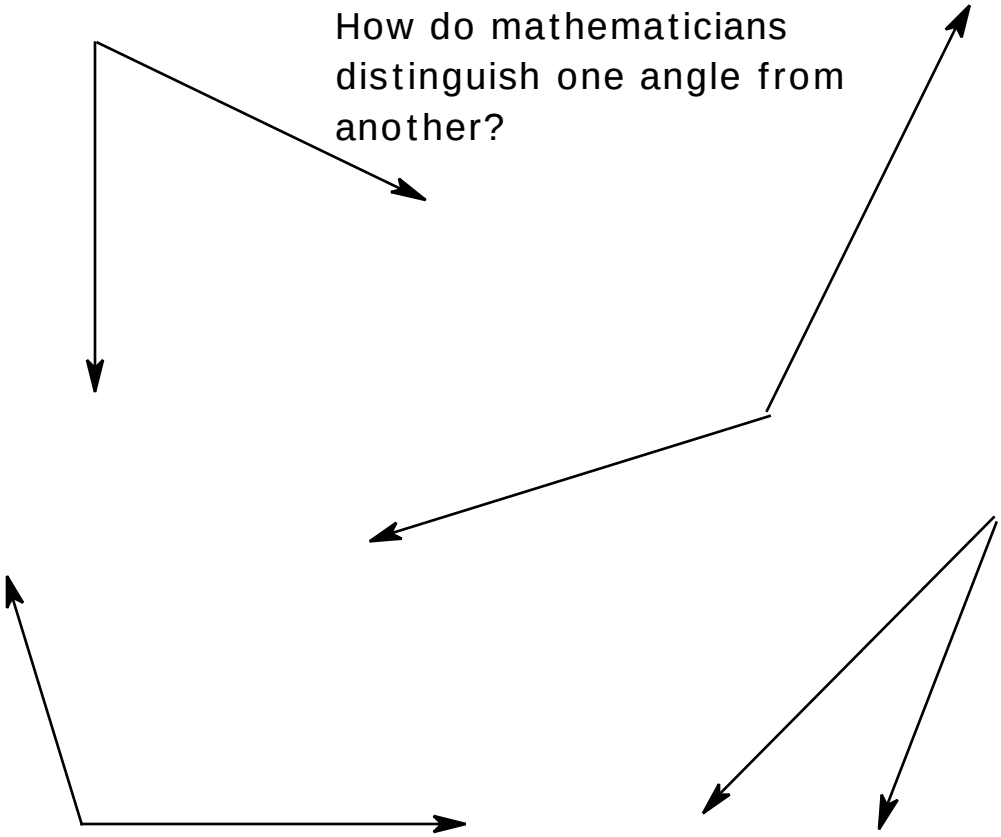
Degrees in a Circle





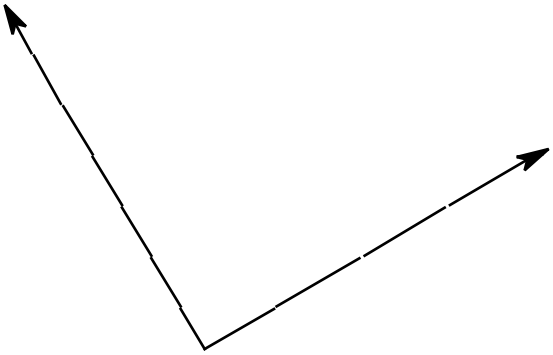
WHAT'S YOUR ANGLE?

How do mathematicians distinguish one angle from another?

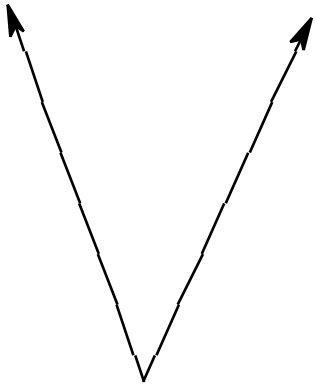


Measuring Angles

Directions Predict the measurement of each angle below. Then use your protractor to find the exact number of degrees in each angle.



Prediction_____
Actual_____



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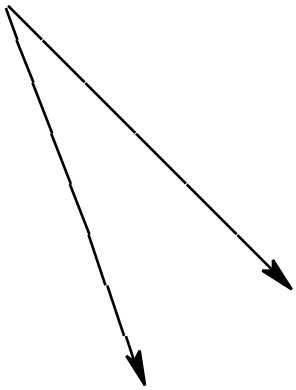
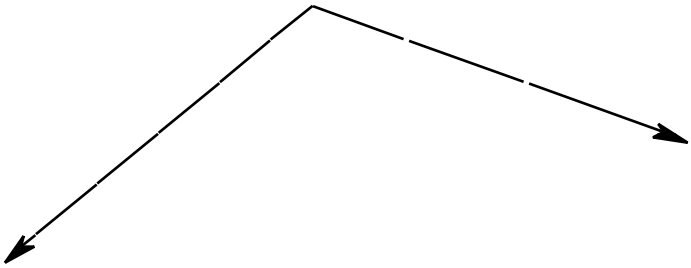


Prediction_____
Actual_____



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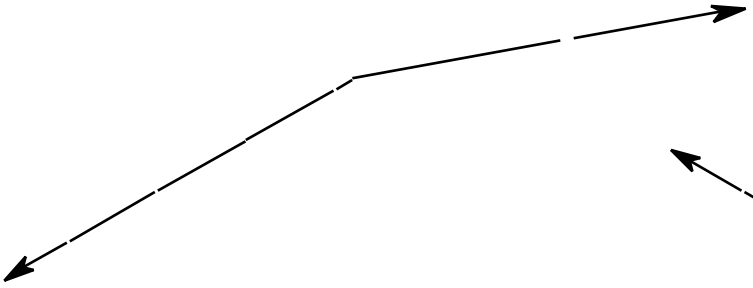

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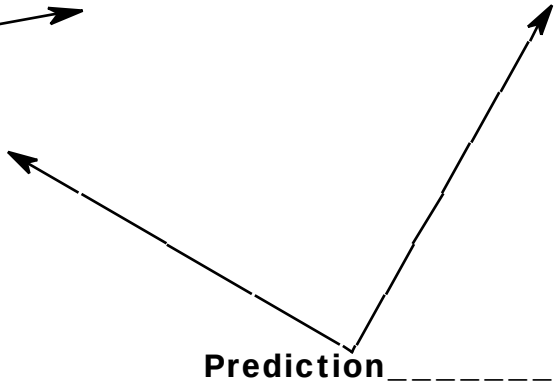

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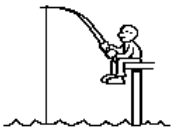
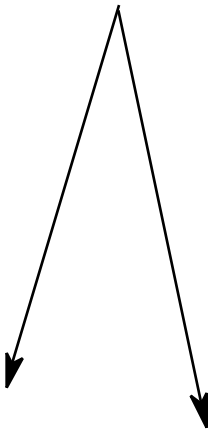
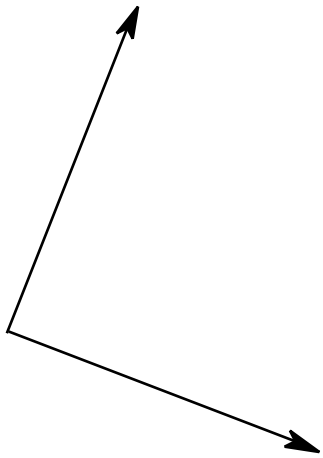


Are You A Skilled Angler?

Directions: Draw and label the following angles in the space provided below: 45 degrees, 125 degrees, 70 degrees, and 170 degrees.

Bonus: Measure and label the angles below by degree and classification.





LOST OR FOUND?

This year, for your school's annual Spring Family Festival, your principal has asked each class to create a station for children and parents to visit during the evening. He wants to have each grade use some skills they have practiced during the school year. Your class has decided to design a scavenger hunt. People participating in your hunt will need to use tools and skills for measuring angles and length in order to collect tokens at each station. Tokens will be turned in for a prize at the end of the hunt.

Your group's task will be to design an interesting scavenger hunt and to write accurate directions for following it.

The class will follow directions, use a rubric to rate each hunt, and vote on which route to use.

Tasks

- Divide your group so that each member has a particular job:

_____ _____
_____ _____

- Brainstorm the materials which you will need to measure out your map accurately so that your materials person can select them.

_____ _____

- Create your route, measuring accurately and recording directions.

- Test your route by following your directions; make adjustments to your directions if necessary.

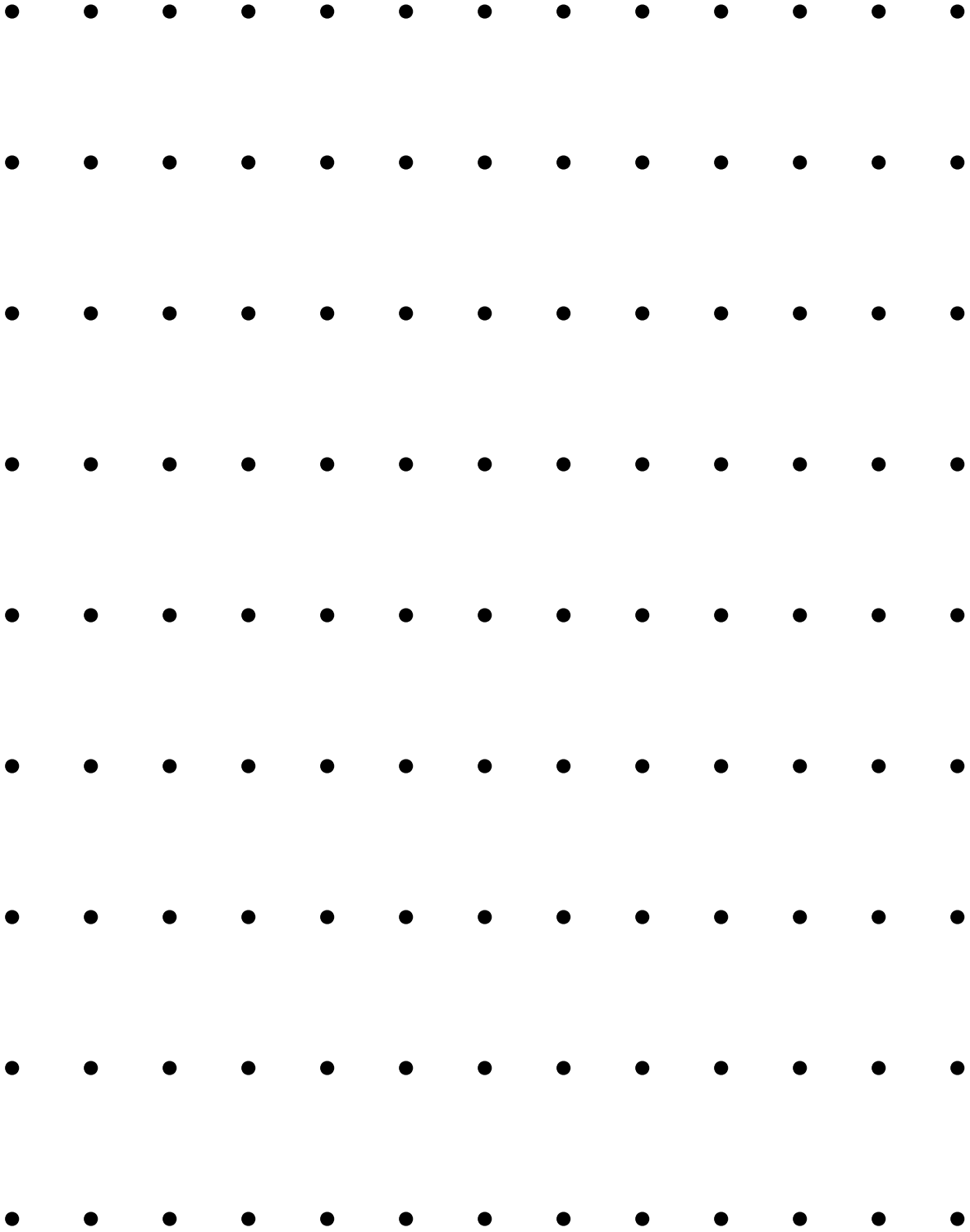
- Copy your directions on an index card and on an overhead.

RUBRIC

Class Evaluation: Name of Group_____

- Put a check in each box which applies to the hunt you are evaluating.
- Then give the hunt an overall score, and
- Add a small paragraph at the bottom explaining why you would or would not choose these directions.

content / score	tools	units	reference point	angles accurate	clarity
4	• Requires use of protractor and/or other useful aids ☐	• Uses appropriate standard units ☐	• Consistently orients measurer at each step ☐	• Completely accurate, chosen for reasonable measurement ☐	• Concise throughout; hunt is easily accomplished ☐
3	• Requires use of protractor ☐	• Uses standard units ☐	• Generally clear where to begin measuring ☐	• Within 5 degrees ☐	• Verbs used, few unneces-sary words, task can be done at home ☐
2	• Uses direction words but may not necessarily require protractor ☐	• May not use standard units ☐	• Inconsistent use of reference point ☐	• Not consistently carefully measured ☐	• Unclear or extra words, • Must re-measure to accomplish task ☐
1	• No tools used, may use horizon or other visual clues ☐	• Does not use standard units ☐	• No reference points used ☐	• Degrees not used or are not correctly measured ☐	• Not possible to follow due to lack of legibility, logical order, etc. ☐



Name _____

Create a Labyrinth

Princess Ariadne needs your help! She wants to assist Theseus in his attempt to escape the labyrinth, but she can't remember the path. She remembers that the maze was symmetrical and passing the following things in the maze:

---- Two yellow parallelograms whose bases are 5 units each.

---- Two green trapezoids whose heights are 2 units each.

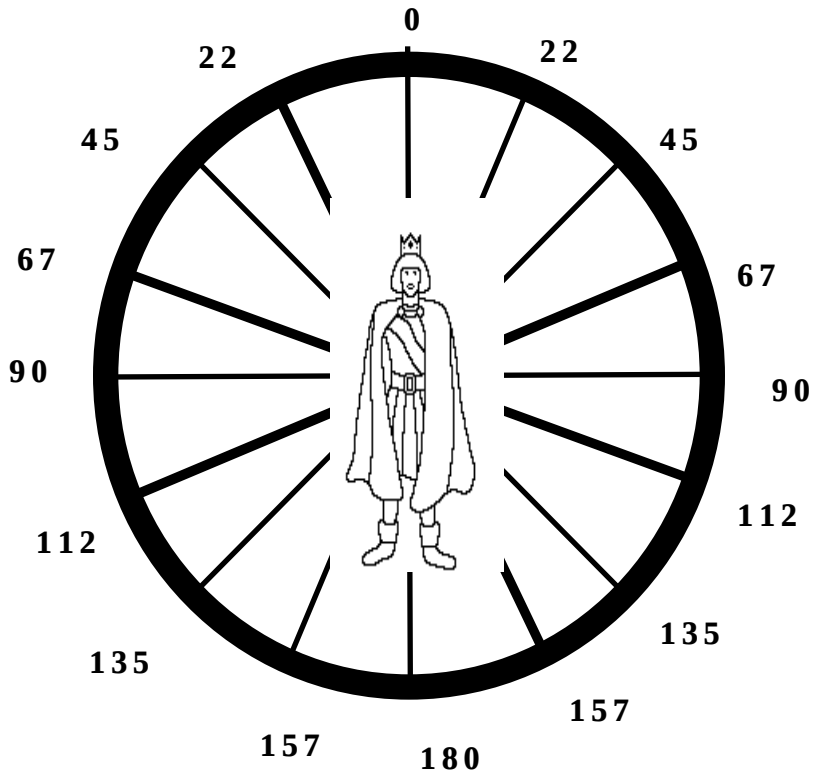
---- One purple rectangle with an area of 8 square units.

---- Two congruent red triangles.

---- One orange triangle that contains an obtuse angle.

---- One blue polygon that contains all right angles.

Using what she remembers about the maze, draw a map of the labyrinth. On a separate sheet of paper, write directions for Theseus to follow to get out of the maze.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180

Ariadne's Map - Sample Response